

Middleware for Data Visualization in VO-enabled Data Archives

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Abstract. We present a middleware for visualization and exploration of complex datasets in a VO framework, that performs interaction between data archives and existing VO client applications using PLASTIC. It comprises: (1) PLASTIC-enabled Java control applet, integrated into archive web-pages and interacting with VO applications; (2) cross-browser compatible JavaScript part managing PLASTIC-aware VO Clients (launch, data manipulation) by means of Java LiveConnect. This (or similar) solution is an essential for the new generation VO-enabled data archives providing access to complex observational and theoretical datasets (3D-spectroscopy, N-body simulations, etc.) through web-interface. Thanks to PLASTIC capabilities it is possible to start all necessary client software with a single-click in the archive query result page in a web-browser. This simplifies the scientific usage of the VO resources and makes it easy even for users with no experience in the VO technologies.

1. Introduction

After several years of intensive development, the International Virtual Observatory has accumulated numerous useful standards, tools, and access protocols allowing users to deal with the astronomical data of almost any kind. The fact that many software products within the Virtual Observatory follow IVOA conventions and standards opens a very promising perspective to attempts of integrating heterogeneous VO tools within end-user's unique environment. One can glue VO tools developed by third parties, providing various feature sets into a VO system based on intercommunication between them, that will dramatically improve usability and/or feature list available to scientific users.

Being somewhat in a contradiction to the “classical” development schema, this approach brings all the power of the VO initiatives to data centres and other service providers involved in development of new services for astronomical needs.

The idea described here is a cornerstone of the approach to visualization of complex observational and theoretical datasets. We have implemented it in several VO-enabled data archives significantly increasing the value that “usual” archive can bring to an astronomer.

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2. Middleware Design

The typical design of a *classical* data archive implies the end-user to:

1. submit a query on a web page to search for a data needed
2. locate a dataset in the search results
3. download or put it to a VO storage service (e.g. VOStore)
4. start a (VO) tool of his choice and open the file inside it for scientific analysis

We propose another way of interaction between a user and a data archive by putting a middle layer between VO-enabled tools residing on a researcher's PC, and a data archive itself. We use the full advantage of PLaatform for Astronomical Tools InterConnection (PLASTIC), a prototype of an application messaging protocol, based on XML-RPC.

Our middleware eliminates some unnecessary steps between the data discovery and analysis phases, significantly simplifying the usage of VO-enabled data archives by end-users. It comprises:

1. PLASTIC-enabled Java control applet, integrated into archive web pages and interacting with VO applications (e.g. CDS Aladin, ESA VOSpec, TOPCAT);
2. Cross-browser compatible JavaScript part managing PLASTIC-aware VO Clients (launch, data manipulation, etc.) by means of Java LiveConnect.

The principal design of the entire middle layer is the following. Java applet *App_control_applet* is embedded into the web pages and started in background once the user looks through the archive search results. The applet waits for a PLASTIC hub to be started and connects to it as soon as it has become available. Since then *App_control_applet* is able to check if a particular VO client application is connected to the PLASTIC hub and control its behaviour by means of PLASTIC messages; for instance an applet can send the data (or instructions to download them) to a proper application.

3. Component Details

App_control_applet has an interface to JavaScript (via Java LiveConnect) enabling a web-browser to:

1. recognize if all the necessary VO tools have been launched
2. launch the desired VO tool by means of Java WebStart
3. send the data requested by the user through archive query interface directly to a dedicated VO application
4. control some other aspects of the VO tools behaviour which are manageable via PLASTIC

This creates a “bridge” between server and client sides, and the server side is able control processes taking place at the client, simplifying user communication with the archive. From the user's point of view it means there is no need anymore to launch the VO clients and download files separately: all these actions can be completed by a single mouse-click from any modern web browser.

The key advantages of the middle layer are the following:

1. It is possible to start all necessary client software with a single-click in the archive query result page in a web-browser.

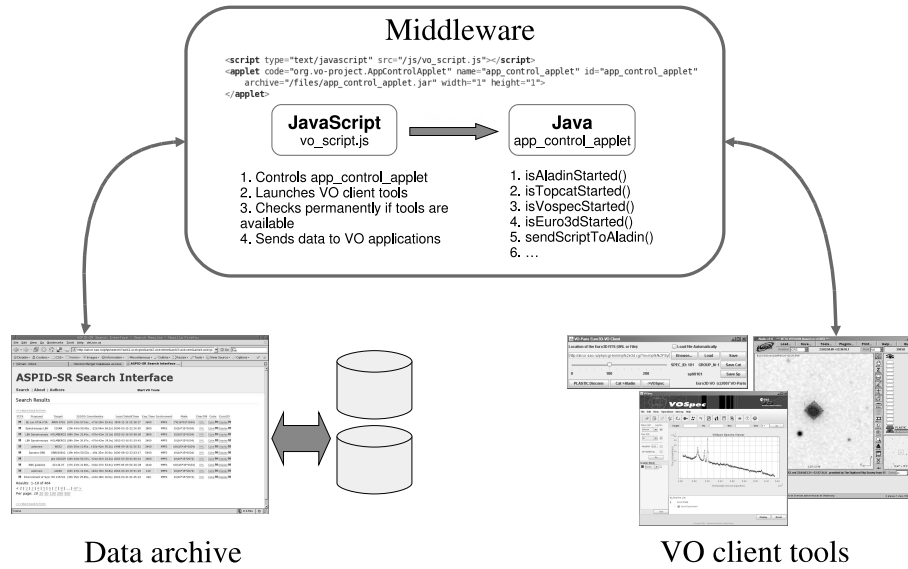


Figure 1. Structure of the middleware.

2. It does not require severe changes in the data archive implementation: only two lines of HTML code are required to embed the middleware in the pages containing query results.
3. It works in any modern web browser.

The prototypes of the data archives with the integrated middleware can be accessed at the following web sites:

- ASPID-SR (Chilingarian et al. 2007), providing access to the fully-reduced 3D spectral datasets, obtained with the Russian 6-m telescope (see technical details in Zolotukhin et al. 2007)
- The Horizon GalMer database, containing results of N-Body simulations of galaxy mergers (Di Matteo et al. 2007a,b)

Details on these implementations and descriptions of interaction between particular VO tools are given in Chilingarian & Zolotukhin (this volume).

4. Summary

The presented solution for simplifying retrieval of and manipulation with the datasets available through VO-enabled data archives is proved to be versatile by two implementations providing access to data of completely different origin. This (or similar) solution is an essential for modern new generation data archives. It greatly simplifies the scientific usage of the VO resources and makes it easy even for astronomers with no experience in the VO technologies.

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